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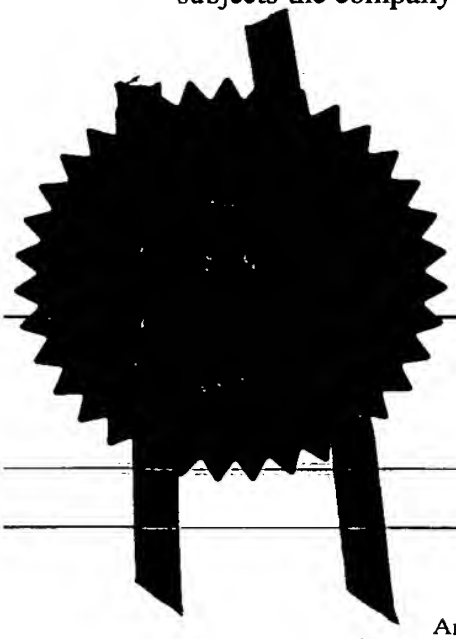

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1. Your reference JM/SK/P96978

2. Patent application number *(The Patent Office will fill in this part)* **9915085.6**

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

Raman Boards Limited
Mysore Ooty Road
Thandavapura-571 325
Mysore District
Karnataka
India

Patents ADP number *(if you know it)*

If the applicant is a corporate body, give the country/state of its incorporation 07689615001

80

4. Title of the invention

AN INSECT REPELLANT DEVICE

5. Name of your agent *(if you have one)*

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

Urquhart-Dykes & Lord
Tower House
Merrion Way
Leeds
LS2 8PA

Patents ADP number *(if you know it)* 1644004

150

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

| Country | Priority application number *(if you know it)* | Date of filing *(day / month / year)* |
|---|---|---|
| | | |

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

| Number of earlier application | Date of filing *(day / month / year)* |
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8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*

YES

*a) any applicant named in part 3 is not an inventor, or*
*b) there is an inventor who is not named as an applicant, or*
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| Priority documents | |
| Translations of priority documents | |
| Statement of inventorship and right to grant of a patent *(Patents Form 7/77)* | 5 / |
| Request for preliminary examination and search *(Patents Form 9/77)* | |
| Request for substantive examination *(Patents Form 10/77)* | |
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11. I/We request the grant of a patent on the basis of this application.

Signature [signature] Date 29/6/99

12. Name and daytime telephone number of person to contact in the United Kingdom: Johnathan McBonough 0113 2452388

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# An insect repellant device

The present invention relates to an insect repellant device comprising a paperboard strip, which includes a substance toxic to insects. The present invention also relates to a method of manufacture of such a device. More particularly, but not exclusively, the present invention relates to a mosquito coil comprising a paperboard coil impregnated with a substance toxic to mosquitoes and a method of manufacturing the same.

Known mosquito coils typically comprise a combustible material, a binder, an organic filler, perfume and insect repellant. Such coils are manufactured by mixing these ingredients into a doughy paste, forming the paste into a sheet by extrusion or pressing, punching out a coil from this sheet and then drying to obtain a finished product.

US-A-5 447 713 discloses a mosquito coil manufactured from wood fibres and/or wood chips and possibly a binder. The mixture of ingredients is pressed to form a board from which the coils are punched. The application of pressure tends to align the fibres within the board so resulting in a board which tends to be brittle. A significant proportion of coils manufactured from such brittle board are damaged either during distribution or by subsequent handling by the consumer.

Accordingly, in a first aspect, the present invention provides an insect repellant device comprising a combustible paperboard strip which includes a substance toxic to insects.

The term paperboard refers to fibrous structures which are made by felting fibres from a fluid suspension.

Since the paperboard is made by felting fibres rather than compressing them the fibres of the paperboard are not aligned during manufacture. The resulting paperboard is far more flexible (and so less brittle) than known boards. An insect repellant device manufactured from such a paperboard is far less likely to be damaged during packing, transit or subsequent handling than mosquito coils made by processes involving compression of the board fibres.

Known mosquito coils also tend to 'dust' i.e. small particles tend to break from the coil during handling. This leaves a fine powder on the hands of the user and on any other surfaces with which the coil has been in contact. A significant mass of the coil can also be lost during transit through dusting leading to a reduction in the performance of the coil. The insect repellant device of the invention has the advantage that it does not 'dust'.

The insect repellant device of the invention is also significantly lighter than known mosquito coils whilst still burning for the same amount of time. This reduces distribution costs.

The insect repellant device of the invention can also be produced in a wide range of colours, known mosquito coils in a limited range of colours, typically green or black.

The insect repellant device of the invention also generates less smoke when burnt than known mosquito coils.

Preferably, the fibres can be cellulosic, preferably waste paper, more preferably at least one of kraft pulp or

newspaper waste. This makes the resulting insect repellant device relatively inexpensive to produce.

The fibres can comprise wood free fibres, preferably at least one of bagasse, straw or bamboo. This improves the flexibility of the resulting paperboard strip. It also reduces the smoke produced when the strip is burnt.

The fluid can be aqueous based, particularly water.

Preferably, the strip is in the form of a coil.

The insect repellant device can further comprise a flexible backing sheet for supporting the combustible paperboard strip. For a large range of strip widths, lengths and thicknesses the paperboard strip tends not to be self supporting. Inclusion of such a backing sheet enables such strips to be used.

Preferably, the flexible backing sheet is not capable of self sustaining combustion. This prevents the backing sheet from burning faster than the paperboard strip.

The paperboard strip can further comprise an organic dye, the organic dye preferably comprising 0.5% to 2% by weight of the paperboard strip. The organic dye improves the combustion properties of the paperboard strip. Addition of the organic dye makes the combustion of the paperboard strip far more resistant to being extinguished by external factors such as a breeze. It also makes combustion insensitive to variations in internal properties of the paperboard strip.

The organic dye can be distributed uniformly throughout the volume of the paperboard strip. This further improves the combustion properties of the paperboard strip.

The paperboard strip can further comprise a charcoal powder, the charcoal powder preferably comprising 1 to 10% by weight of the paperboard strip. The charcoal powder improves the combustion of the paperboard strip.

The paperboard strip can have a substantially rectangular cross section, the thickness of the strip preferably being at least 0.2mm, more preferably at least 0.6mm; preferably not more than 1.9mm, more preferably not more than 1.8mm. Preferably the width of the strip is at least 2mm, more preferably at least 5mm; preferably not more than 6mm. Such paperboard strips tend to exhibit a uniform burn rate and are not prone to self extinguish.

Preferably the density of the paperboard strip is at least 400Kgm$^{-3}$, more preferably at least 550Kgm$^{-3}$; preferably not more than 750Kgm$^{-3}$, more preferably not more than 650Kgm$^{-3}$. Such paperboard strips exhibit a long burn time and have a low weight.

In a further aspect of the invention there is provided an insect repellant device manufactured by a process comprising the steps of

adding a furnish comprising fibrous structures to a fluid to form a fluid suspension;

felting the fibrous structures from the fluid suspension to form a mesh of interlocked fibrous structures;

drying the mesh to form a paperboard; and,

~~adding a substance toxic to insects to the paperboard.~~

The insect repellant device according to this further aspect of the invention has the advantage of being flexible and so is less likely than known coils to be damaged during transit or whilst being handled by the consumer.

In a further aspect of the invention there is provided a method of manufacture of an insect repellant device comprising the steps of

adding a furnish comprising fibrous structures to a fluid to form a fluid suspension;

felting the fibrous structures from the fluid suspension to form a mesh of interlocked fibrous structures;

drying the mesh to form a paperboard; and,

adding a substance toxic to insects to the paperboard.

The resulting insect repellant device is flexible and so is less likely to be damaged than known devices either during transit or whilst being handled by the consumer.

Preferably the method further comprises the step of cutting the paperboard to form a strip, preferably a coil.

The method can further comprise the step of adhering the paperboard to a flexible backing sheet with an adhesive. The method can also include the step of drying the adhesive whilst restraining the paperboard and backing sheet to prevent distortion of the paperboard.

The furnish can comprise waste paper, preferably at least one of kraft pulp or newspaper waste. This makes the resulting

insect repellant device relatively inexpensive to produce. It also reduces the weight of the device.

The furnish can comprise wood free fibres, preferably at least one of bagasse, straw or bamboo. This improves the flexibility of the resulting paperboard strip. It also reduces the amount of smoke produced when the strip is burnt. The use of wood free fibres rather than wood pulp is also environmentally friendly.

The method can further comprise the step of adding at least one of charcoal powder or an organic dye to the fluid suspension. Preferably the organic dye is saturated or impregnated into the paper board. This improves the combustion properties of the resulting coil.

The method can further comprise the step of adding an organic dye to the paperboard, preferably by wet saturation.
The present invention will now be described by way of example only, and not in any limitative sense, with reference to the accompanying drawings in which:

figure 1 shows a mosquito coil according to the invention in plan view;

figures 2(a) to 2(d) show further embodiments of mosquito coils according to the invention in plan view;

figure 3 illustrates the variation in burn rate with thickness for a rectangular paperboard strip of a mosquito coil according to the invention;

figure 4 illustrates the variation in burn rate with width for a rectangular paperboard strip of a mosquito coil according to the invention;

figure 5 shows the variation in burn rate with density for a paperboard strip of a mosquito coil according to the invention.

Shown in figure 1 is a mosquito coil according to the invention. The mosquito coil comprises a backing sheet 1 and a paperboard coil 2. The backing sheet 1 is a flexible paper sheet. The role of the backing sheet 1 is twofold: firstly, it provides reinforcement for the paperboard coil 2 so producing a dimensionally stable, flat, easy to handle coil; secondly, it enhances the performance of the coil by cutting off the air supply to one side of the paperboard coil 2 from one side. This reduces the burn rate of the paperboard coil 2 by typically 20%.

The paper backing sheet 1 is treated with a flame retardant additive to make it incapable of self sustaining combustion. When the paperboard coil 2 is lit then the portion of the backing sheet 1 proximate to the burning end of the paperboard coil 2 may burn. However, because the backing sheet 1 cannot sustain combustion, combustion of the backing sheet 1 will not spread to areas of the backing sheet remote from the burning end of the paperboard coil 2. The combustion of the backing sheet 1 will therefore closely follow the paperboard coil 2, it will not track across the backing sheet 1 away from the paperboard coil 2. This also burns at the same rate as the paperboard coil 2.

The paper backing sheet 1 is manufactured from newsprint stock. This has the advantage that it can be coloured easily. It also combines a good rigidity with low weight characteristics. The low weight of the backing sheet 1 significantly reduces the cost associated with distribution of the mosquito coil. The grammage per square meter of the

paper backing sheet 1 is usually chosen to lie within the range 0.03 to 0.1Kgm$^{-2}$, in this case 0.055Kgm$^{-2}$

In order to manufacture the paperboard coil of this embodiment a furnish comprising of predominantly waste paper is taken and slushed along with an unbleached kraft pulp and newspaper waste. Wastepaper containing predominantly wood free fibres are used, for example bagasse, straw or bamboo. Such fibres give the resulting paperboard an excellent strength and density. Wood free fibres are also relatively inexpensive. A typical composition of the furnish is

| Furnish | Dry weight |
|---|---|
| Waste paper (high % of wood free fibre) | 75 |
| Unbleached wood pulp | 10 |
| Newsprint waste | 15 |

The slushing is done in water at a consistency of 2.5% in a hydropulper, which is well known in the papermaking art. After disintegrating the furnish so that an evenly mixed slurry of the fibre is obtained an inorganic filler (for example calcium carbonate) is added and dispersed evenly by known methods. Immediately after this the pH of the mixture is raised to between 7 and 8 by, for example, the addition of sodium aluminate.

The slurry is then passed through a mild refining process well known in the papermaking art which results in a well dispersed fibre. After refining a solution of a cationic retention aid, (for example Sursolan K12L of BASF) is added which has the effect of fixing the inorganic filler to the fibre.

Optionally an organic dye is added to the slurry, or preferably impregnated into the wet paperboard to enhance both the colour and burning characteristics of the final paperboard. Paperboards having an organic dye concentration in the region of 0.5 to 2% of the weight of the paperboard are to be preferred as this makes the combustion of the paperboard far more resistant to being extinguished by external factors such as a breeze. It also makes combustion more insensitive to internal properties of the paperboard.

Optionally, a charcoal powder is added to the slurry during manufacture of the paperboard. This also improves the combustion properties of the resulting paperboard, particularly if the charcoal powder comprises 1 to 10% by weight of the paperboard.

The slurry is then diluted to about 0.6% consistency and pumped to the headbox of a papermaking machine. The fibres are then felted from solution to form a mesh. The mesh is finally dried on conventional papermaking cylinders to form paperboard and sheeted at the end of the process.

By known papermaking techniques the density of the paperboard produced by the paper making machine is controlled to a target density of 0.55 g/cc and a thickness of 1.5mm. Other thicknesses and densities are possible as discussed below.

A coil of the desired shape is then punched from the paperboard sheet and coated with an insect repellant. Coating can be done by known coating or printing techniques. One example of such a technique is to spray the coil with insect repellant and then allow it to air dry. The resulting coil has an ash content of $3.4*10^{-5}$ Kg/m (0.00034g/cm) and a burn rate of approximately $6.6*10^{-5}$ m/s (0.4cm/min).

The paperboard coil 2 is adhered to the backing sheet 1 by a starch or dextrin adhesive, typically with a solids content in the range 5% to 10%. The drying of the adhesive will cause the backing sheet 1 to shrink and the paperboard coil 2 to distort. To prevent this the paperboard coil 2 and backing sheet 1 are held under pressure between two plates in the form of a moving conveyor and the bottom plate is heated slightly to dry out the adhesive. In alternative embodiments other types of adhesive are used.

The paperboard coil 2 shown in figure 1 has a total length of 1.8m, a strip width of 5mm and a burn rate of $6.6*10^{-5}$ m/s (0.4 cm/min). The coil will therefore burn for approximately 7.5 hours.

Shown in figures 2(a) to 2(d) are a number of other embodiments of mosquito coils according to the invention.

The paperboard coil 2 of the mosquito coil shown in figure 1 has a rectangular cross section. The width, thickness and density of the paperboard coil 2 greatly influence the burn rate.

Shown in figure 3 is a graph of $(\text{burn rate})^{-1}$ vs paperboard coil thickness at a constant coil width of 5mm and a density of 570 $Kgm^{-3}$ (0.57 g/cc). As the thickness of the paperboard coil is increased towards 1.8mm the $(\text{burn rate})^{-1}$ increases from 6000 s/m to 15000 s/m (1min/cm to 2.5min/cm). At thicknesses larger than this the burn performance becomes uncertain with a marked tendency for the flame to extinguish itself. Mosquito coils of the invention have paperboard coils 2 having an optimum thickness of 1.5mm, although paperboard coils 2 having thicknesses in the range 0.2 to 1.9mm (more preferably in the range 0.6 to 1.8mm) perform well.

Shown in figure 4 is a graph of (burn rate)$^{-1}$ vs paperboard coil width at a constant thickness of 1.5mm and a density of 570 Kgm$^{-3}$ (0.57g/cc). As can be seen, the burn rate drops as the coil widens, with the optimum width being reached at 5-6mm. Thereafter the burn rate becomes uncertain with a marked tendency of the flame to extinguish itself. Coil widths in the range 2 to 6 mm (more preferably in the range 5 to 6mm) perform well.

Shown in figure 4 is a graph of (burn rate)$^{-1}$ vs paperboard coil density. As the density increases the porosity of the board is reduced causing the burn rate to lessen to the point of the flame being extinguished. As shown in figure 4 the burn rate slows down with increasing density until it is optimised at a density of approximately 550 Kgm$^{-3}$ (0.55g/cc). Thereafter the increase in paperboard density has only a very small to negligible impact on the burn rate up to a density of 740 Kgm$^{-3}$ (0.74g/cc). Paperboard coils according to the invention typically have densities in the range 400 to 750 Kgm$^{-3}$ (0.4 to 0.75g/cc). Densities in the range 550 to 650 Kgm$^{-3}$ (0.55 to 0.65g/cc) are to be preferred.

Claims

1. An insect repellant device comprising a combustible paperboard strip which includes a substance toxic to insects.

2. An insect repellant device as claimed in claim 1, wherein the strip is in the form of a coil.

3. An insect repellant device as claimed in either one of claims 1 or 2, further comprising a flexible backing sheet for supporting the combustible paperboard strip.

4. An insect repellant device as claimed in claim 3, wherein the flexible backing sheet is not capable of self sustaining combustion.

5. An insect repellant device as claimed in any one of claims 1 to 4, wherein the paperboard strip further comprises an organic dye, the organic dye preferably comprising 0.5% to 2% by weight of the paperboard strip.

6. An insect repellant device as claimed in claim 5, wherein the organic dye is distributed substantially uniformly throughout the volume of the paperboard strip.

7. An insect repellant device as claimed in any one of claims 1 to 6, wherein the paperboard strip further comprises a charcoal powder, the charcoal powder preferably comprising 1 to 10% by weight of the paperboard coil.

8. An insect repellant device as claimed in any one of claims 1 to 7, wherein the paperboard strip has a substantially rectangular cross section, the thickness of the strip preferably being at least 0.2mm, more preferably at

least 0.6mm; preferably not more than 1.9mm, more preferably not more than 1.8mm.

9. An insect repellant device as claimed in claim 8, wherein the width of the strip is at least 2mm, preferably a least 5mm; preferably not more than 6mm.

10. An insect repellant device as claimed in any one of claims 1 to 9, wherein the density of the paperboard strip is at least 400Kgm$^{-3}$, preferably at least 550Kgm$^{-3}$; preferably not more than 750Kgm$^{-3}$, more preferably not more than 650Kgm$^{-3}$.

11. An insect repellant device as claimed in any one of claims 1 to 10 manufactured by a process comprising the steps of

adding a furnish comprising fibrous structures to a fluid to form a fluid suspension;

felting the fibrous structures from the fluid suspension to form a mesh of interlocked fibrous structures;

drying the mesh to form a paperboard; and,

adding a substance toxic to insects to the paperboard.

12. A method of manufacture of an insect repellant device comprising the steps of

adding a furnish comprising fibrous structures to a fluid to form a fluid suspension;

felting the fibrous structures from the fluid suspension to form a mesh of interlocked fibrous structures;

drying the mesh to form a paperboard; and,

adding a substance toxic to insects to the paperboard.

13. A method as claimed in claim 12, further comprising the step of cutting the paperboard to form a strip, preferably a coil.

14. A method as claimed in either of claims 12 or 13, further comprising the step of adhering the paperboard to a flexible backing sheet with an adhesive.

15. A method as claimed in claim 14, further comprising the step of drying the adhesive whilst restraining the paperboard and backing sheet to prevent distortion of the paperboard.

16. A method as claimed in any one of claims 12 to 15, wherein the furnish comprises waste paper, preferably at least one of kraft pulp or newspaper waste.

17. A method as claimed in any one of claims 12 to 16, wherein the furnish comprises wood free fibres, preferably at least one of bagasse, straw or bamboo.

18. A method as claimed in any one of claims 12 to 17, further comprising the step of adding at least one of charcoal powder or an organic dye to the fluid suspension.

19. A method as claimed in any one of claims 12 to 18, further comprising the step of adding an organic dye to the paperboard, preferably by wet saturation.

20. An insect repellant device substantially as hereinbefore described.

21. An insect repellant device substantially as hereinbefore described with reference to the drawings.

22. A method of manufacture of an insect repellant device substantially as hereinbefore described.

23. A method of manufacture of an insect repellant device substantially as hereinbefore described with reference to the drawings.

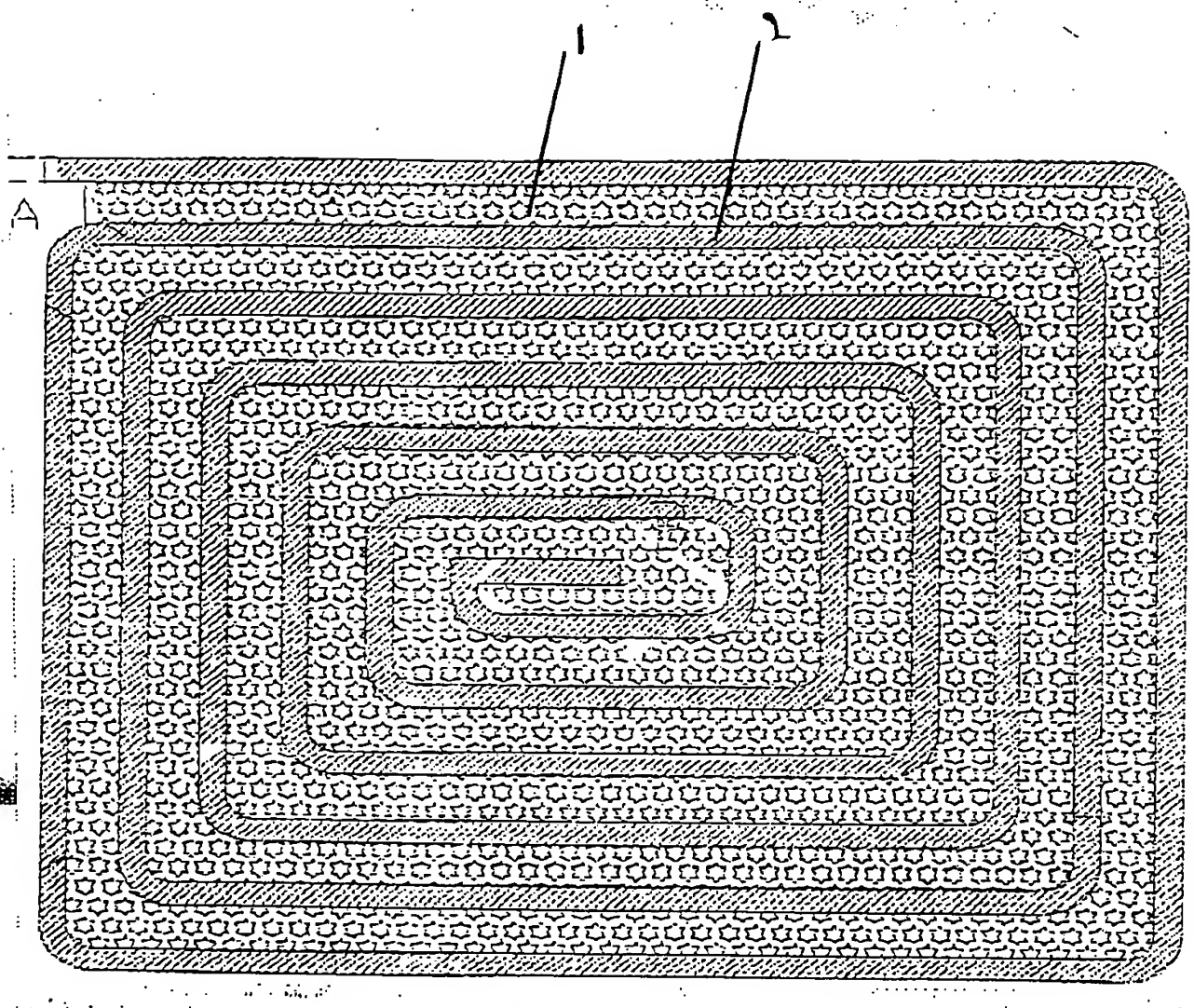



Figure 1

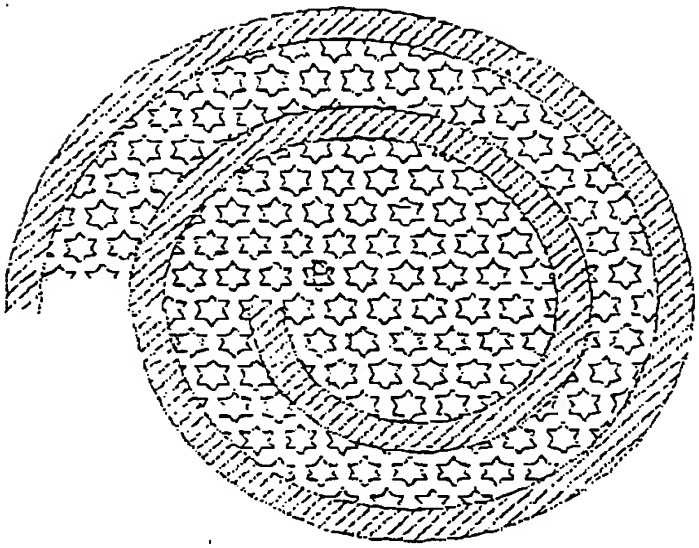


FIG 2(A)

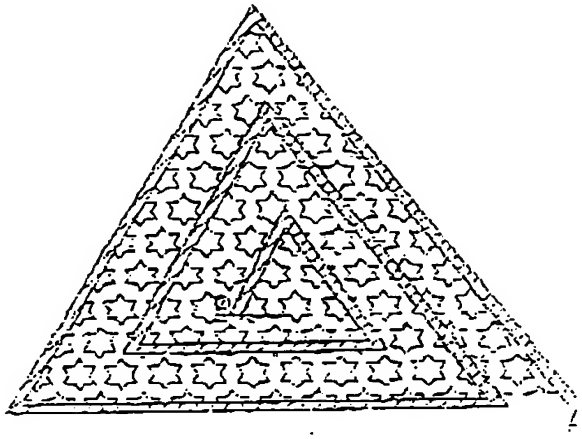
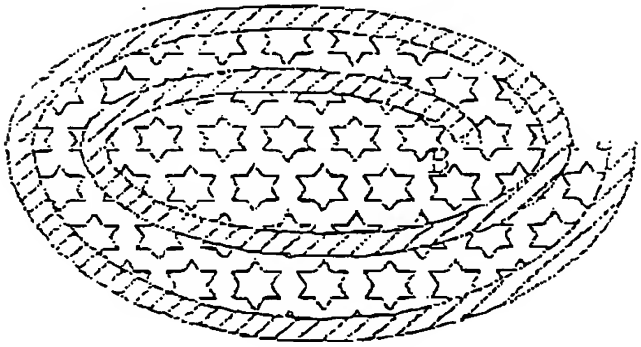
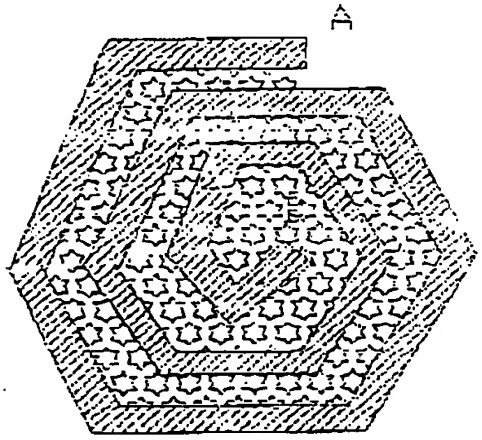


FIG 2(B)



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Variation of Burn Rate as a Function of Thickness at a width of 5mm and Density of 570 kgm$^{-3}$

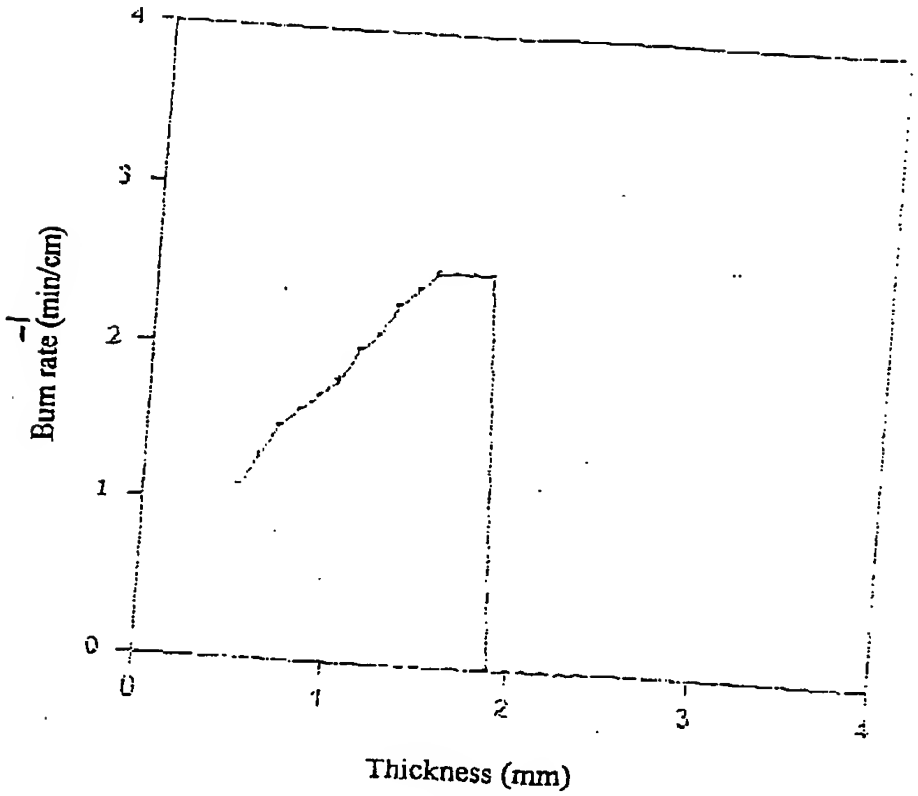


Figure 3

Variation of Burn Rate as a Function of width at a Thickness of 1.5mm and a Density of 0.57.

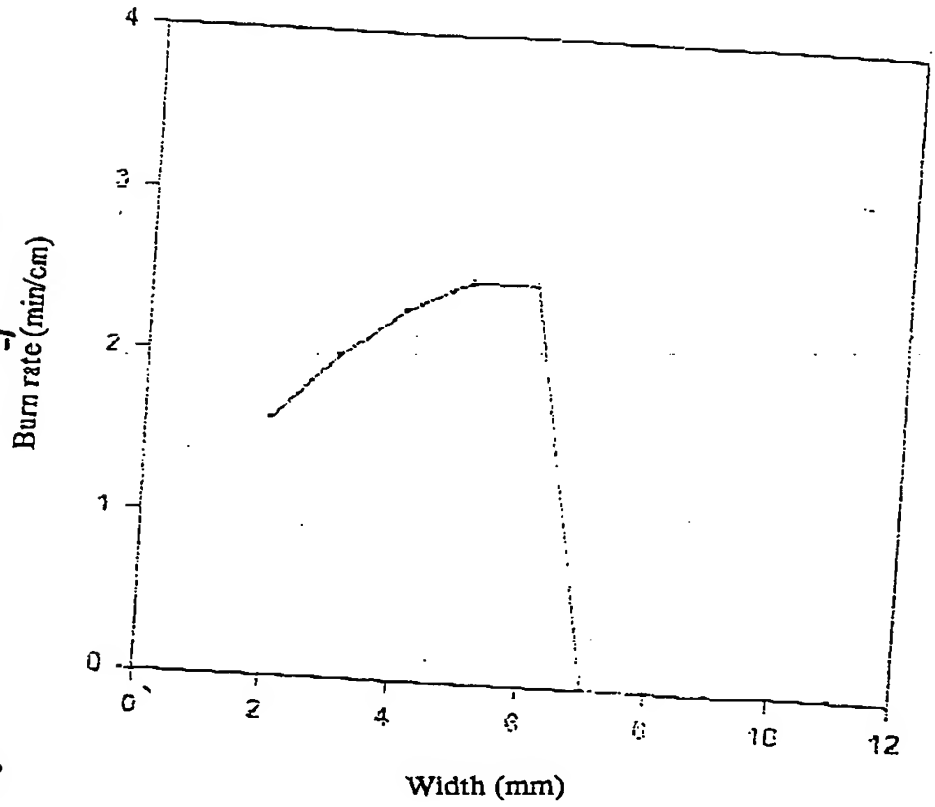


Figure 4

Variation of Burn Rate as a Function of Density at a Width of 5mm and a Thickness of 1.5mm

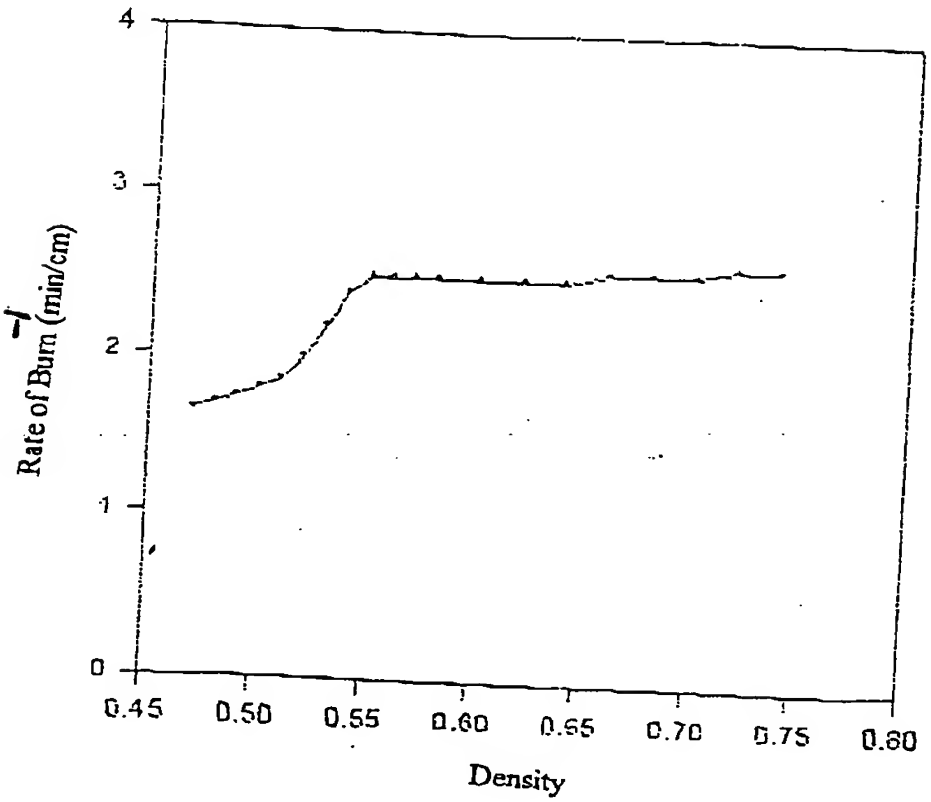


Figure 5